



MODEL ANALYSIS FOR THE MAGIC TELESCOPES

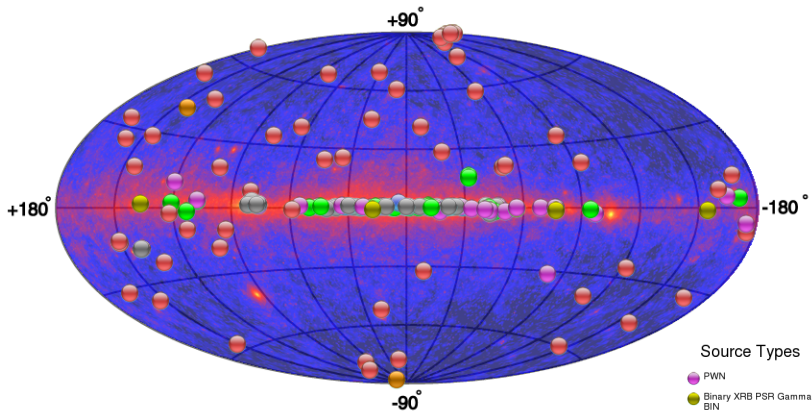
Uta Menzel

YSW Ringberg 2014, 17. 7. 2014

Outline

- ▶ MAGIC telescopes
- ▶ Current analysis
- ▶ Model analysis

The sky in gamma rays

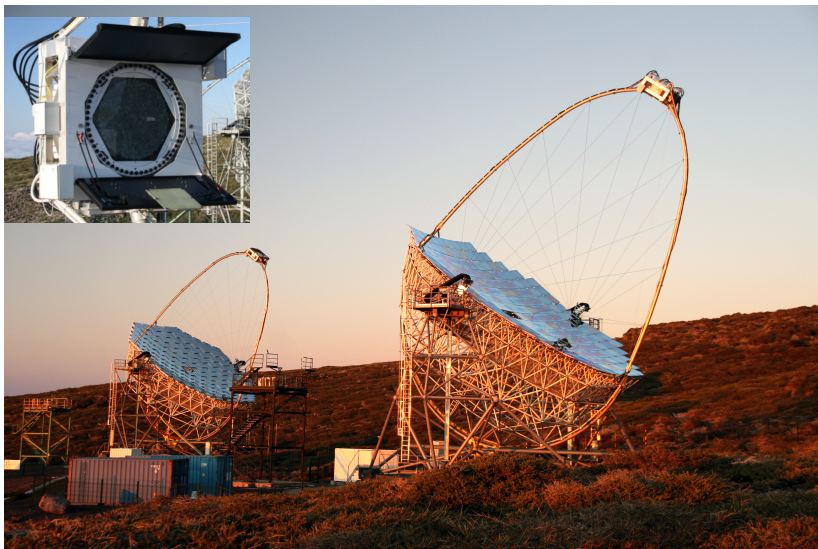


<http://tevcat.uchicago.edu/>

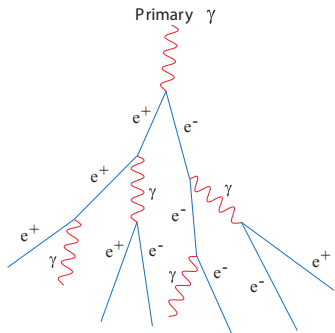
Air Cherenkov telescopes opened new domain of astronomy at very high energies ($E > 100$ GeV)

Source Types

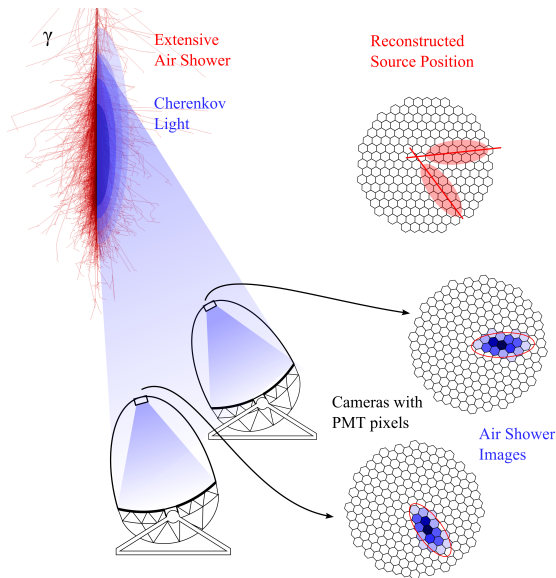
- PWN
- Binary XRB PSR Gamma BIN
- HBL IBL FRI FSRQ LBL AGN (unknown type)
- Shell SNR/Molec. Cloud Composite SNR
- Starburst
- DARK UNID Other
- uQuasar Star Forming Region Globular Cluster Cat. Var. Massive Star Cluster BIN BL Lac (class unclear) WR



Electromagnetic shower

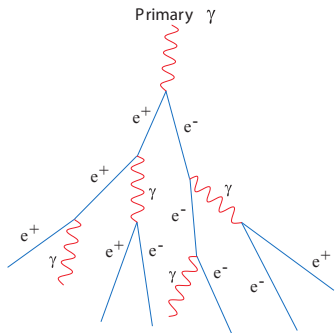


Imaging Air Cherenkov Technique

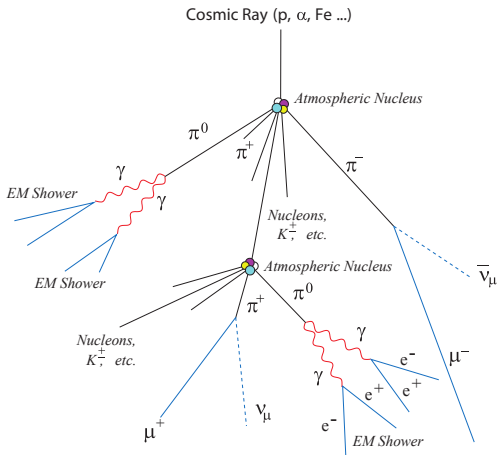


- ▶ image with elliptic shape
- ▶ background from cosmic rays, factor 1000

Electromagnetic shower

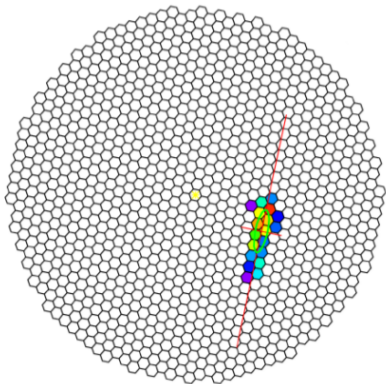


Hadron shower

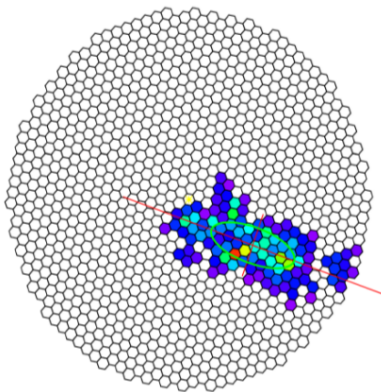


Shower in the Camera

Gamma



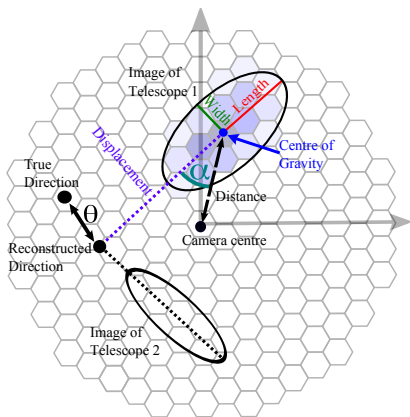
Proton



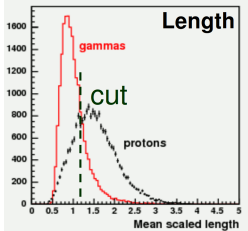
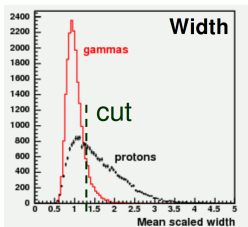
Current Analysis

- ▶ calibrate
- ▶ clean image
- ▶ parametrize

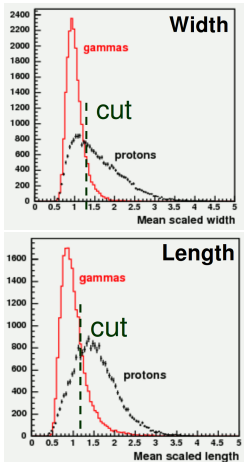
Hillas Parameters



Current Analysis



Current Analysis



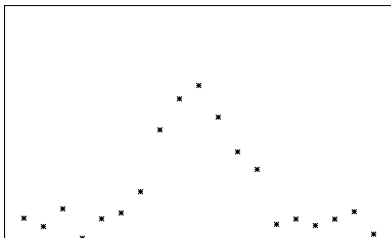
- ▶ Random Forest = many decision trees
- ▶ build with MC-gammas and real background
- ▶ determine hadronness for data

Model analysis

- ▶ parametrization may lose information

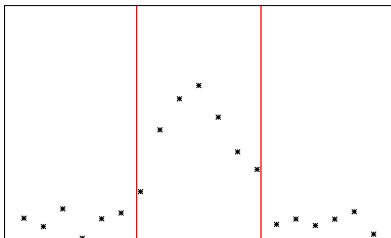
Model analysis

- ▶ parametrization may lose information



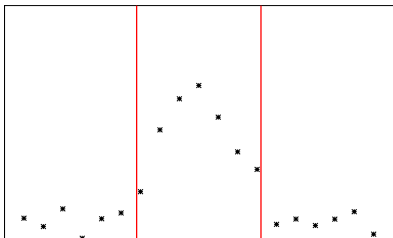
Model analysis

- ▶ parametrization may lose information



Model analysis

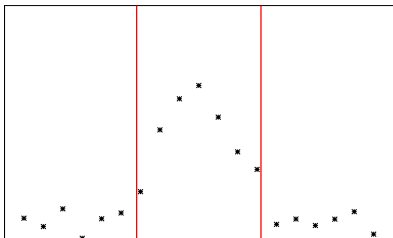
- ▶ parametrization may lose information



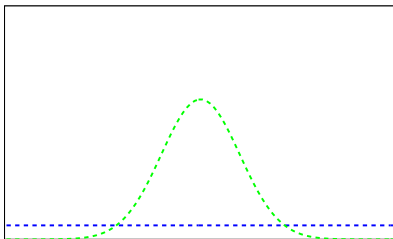
- ▶ \Rightarrow fit a "perfect" image

Model analysis

- ▶ parametrization may lose information

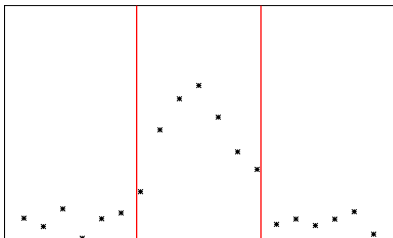


- ▶ \Rightarrow fit a "perfect" image

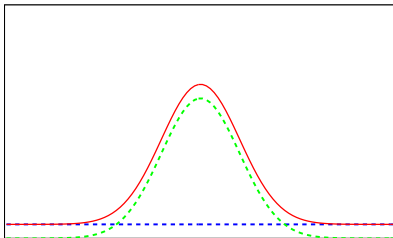


Model analysis

- ▶ parametrization may lose information

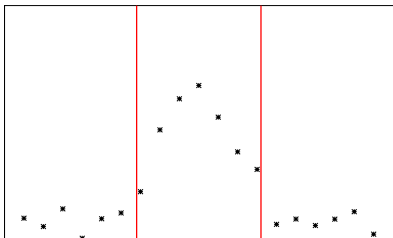


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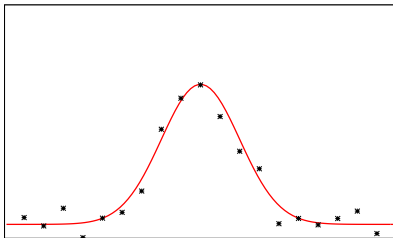


Model analysis

- ▶ parametrization may lose information

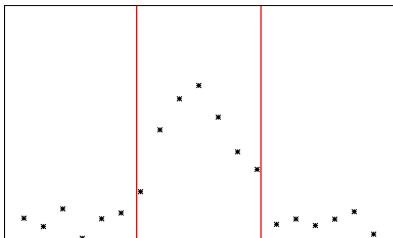


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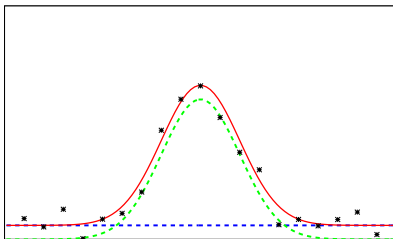


Model analysis

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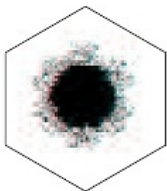


- ▶ \Rightarrow fit a "perfect" image

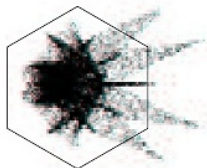


Model analysis

- ▶ template base with MC-simulations
- ▶ parameters: Energy, source position, telescope position, ...
- ▶ result: image in the camera plane, much finer bins
information: arrival time, amount of photons
- ▶ additionally: response of the telescopes

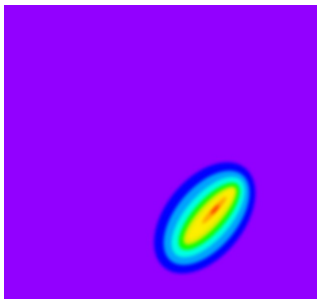


psf in center

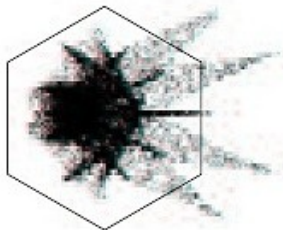


psf outside

Model analysis

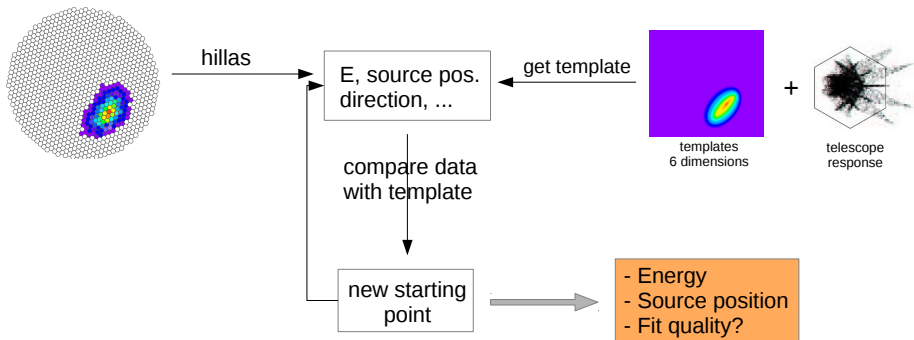


templates
6 dimensions



telescope
response

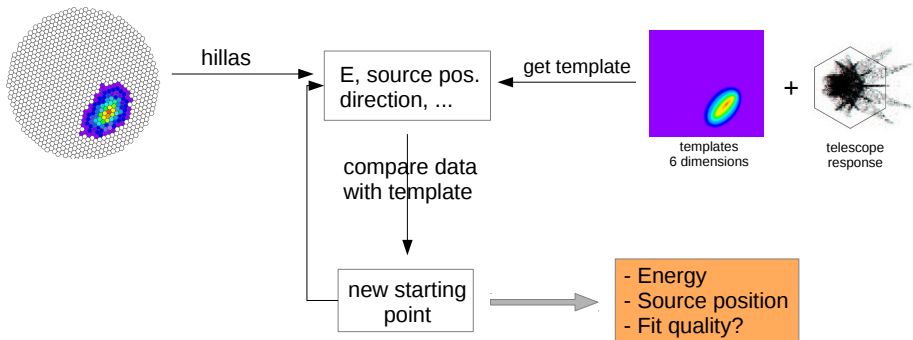
Model analysis



Model analysis

- ▶ compare real image pixel by pixel with averaged template
- ▶ use likelihood method
- ▶ include background

Model analysis



SUMMARY

- ▶ current analysis: comparing parameters
- ▶ model analysis: comparing images (pixels)
- ▶ done in HESS and for MAGIC mono
- ▶ expect to increase sensitivity
- ▶ additional, independent analysis method